Fiscal Year:	FY 2020	**Task Last Updated:**	FY 03/20/2020
PI Name:	Roma, Peter Ph.D.		
Project Title:	Human Factors and Behavioral Performance Exploration Measures in HERA		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **Team**:Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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PI Organization Type:	NASA CENTER	**Phone:**	
Organization Name:	KBR/NASA Johnson Space Center		
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City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	36
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	12/01/2016	**End Date:**	01/21/2021
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	2	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	4	**Monitoring Center:**	NASA JSC
Contact Monitor:	Williams, Thomas	**Contact Phone:**	281-483-8773
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Flight Program:			
Flight Assignment:	NOTE: Title change to Human Factors and Behavioral Performance Exploration Measures in HERA (previous title: Identification and Validation of BHP Standard Measures in HERA for Transport) in February 2020, per PI and HFBP HRP (Ed., 3/31/2020) NOTE: End date changed to 1/21/2021 per L. Juliette/HFBP HRP element (Ed., 2/6/2020) NOTE: Extended to 9/30/2019 (original end date was 7/01/2018) per D. Arias/HFBP at JSC (Ed., 9/13/18) NOTE: Extended to 9/30/2018 (original end date was 7/01/2018) per D. Arias/HFBP at JSC (Ed., 8/31/18)		
Key Personnel Changes/Previous PI:	2020 January: Sara Whiting, Ph.D. joined the project as Co-Investigator. 2019 September: Suzanne T. Bell, Ph.D. joined the project as Co-Investigator. 2019 July: Jason S. Schneiderman, Ph.D. is no longer with the project. 2018 January: Co-Investigators William B. Vessey, Ph.D., Alexandra M. Whitmire, Ph.D. are no longer with the project following their move to other NASA positions. 2017 January: Original Principal Investigator (PI) Thomas J. Williams, Ph.D. no longer with the project following move to Human Factors & Behavioral Performance (HFBP) Element Scientist. 2017 January-July: Jason S. Schneiderman, Ph.D. served as interim PI. 2017 July-Present: Peter G. Roma, Ph.D. joined NASA as BHP Laboratory Lead and Principal Investigator. Project established in 2018 with Dr. Roma as PI.		

COI Name (Institution):	Landon, Lauren Ph.D. (BHP Laboratory, KBR/NASA Johnson Space Center) Bell, Suzanne T. Ph.D. (BHP Laboratory, KBR/NASA Johnson Space Center) Whiting, Sara Ph.D. (BHP Laboratory, KBR/NASA Johnson Space Center)
Grant/Contract No.:	Directed Research
Performance Goal No.:	
Performance Goal Text:	

Task Description:

NASA's Human Research Program (HRP) is developing a set of "Standard Measures" for use in spaceflight and analogs. These "standard measures" need to be validated in analog settings to ensure their validity, acceptability, and reliability in helping identify and measure indicators of risk associated with crew health and performance. Exploration missions are anticipated to create isolated and confined environments that will include stressors such as small teams living and working in extreme conditions for prolonged periods separated from family, friends; loss of the day/light cycle; loss or delay of communications with ground; partial gravity; and limited space, privacy, and food selection. HRP's Human Factors and Behavioral Performance (HFBP) Element seeks to maintain and enhance behavioral health and performance in such environments. The Behavioral Medicine risk (Risk of Adverse Behavioral or Behavioral Conditions and Psychiatric Disorders) is a high priority within the HRP because psychological and behavioral health factors reveal intra- and inter-individual variability. This variability poses significant challenge for measurement of risk and resilience in crews and individual astronauts during long-duration missions.

The HFBP-EM will build upon the initial use and identification of Behavioral Core Measures (BCM), whose purpose was to evaluate the feasibility and acceptability of these outcome measures (Dinges; NNJ13ZSA002N-BMED; project title: "Standardized Behavioral Measures for Detecting Behavioral Health Risks during Exploration Missions") in high fidelity analogs. The task proposed here provides an opportunity to continue using standardized measures in order to operationalize their efficiency and effectiveness, ensure consistent measurement of these key metrics, and facilitate the analysis and understanding of these measures in assessing risk. The development and use of these expanded standardized measures are needed now to develop astronaut norms in order to determine their efficacy and ability to objectively detect, assess, and manage off nominal events; and predict future off nominal events that may compromise a mission and increase the risk of behavioral health and performance decrements. This advances our need for individualized, real-time tools that provide rapid feedback and assessment that are needed for exploration class missions. The use of BHP (Behavioral Health and Performance) Standard Measures across analogs and analog missions, allows NASA Human Research Program (HRP) to determine a baseline for assessing and monitoring specific countermeasures; and increases the construct and predictive validity of countermeasures for assessing risk and for their monitoring of behavioral health and performance in spaceflight.

Specific Aims for the current proposal include:

Aim 1. Provide a set of BHP standard measurements for investigators to use in proposed projects. Significance: This allows NASA HRP to streamline and make more efficient the use of multiple measurements collected on research participants during analog research and helps to ensure a reduced burden on these research participants by using a "standard" set of measures for data sharing by multiple principal investigators (PIs).

Aim 2. Enable comparison of multiple missions across spaceflight analog campaigns to quantify risk using reliable metric-based data. Significance: The "standardized measures" increases the generalization of findings across research analogs, increasing the validity and reliability of measures used to quantify, characterize, and assess the impact of spacelike analogs on prevalence of behavioral health issues, incidence rates, longer term health, and performance errors. This allows generation of reliable and sensitive metrics that can be used systematically to inform accurate risk assessment and mitigation status for future exploration spaceflight missions.

Aim 3. Provide database for data-mining and integrative modeling and increase research data quality and transfer to the Life Sciences Data Archive (LSDA). Significance: Collection of "Standardized Measures" allows for greater consistency and fidelity of data collected, enhancing the data archiving capabilities of analog outcomes, increasing accessibility of data for NASA use, metrics assessment associated with red to yellow, and yellow to green risk status, and trending, and increasing the probability that the standardized set of measures are appropriately archived in a timely manner. Although data management agreements require PIs to submit their data after completion of their research, the exact format and timeliness of that data submission varies greatly among PIs. The collection of "standardized measures" via internal directed studies helps to ensure more timely, valid, and accessible data resources to help guide risk reduction.

NOTES 2018 August: Original Principal Investigator (PI) was Thomas J. Williams, PhD, who became HRP Human Factors & Behavioral Performance (HFBP) Element Scientist shortly after the award was made; Jason S. Schneiderman, Ph.D. served as interim PI until July 10, 2017, when Peter G. Roma, Ph.D. came to Johnson Space Center and became Principal Investigator. At that time, title was changed to "Identification and Validation of BHP Standard Measures in HERA for Transport" (original title was "Identification and Validation of BHP Standard Measures").

2020 February: Project title was changed to "Human Factors and Behavioral Performance Exploration Measures in HERA" (Short Title: HFBP-EM in HERA).

Rationale for HRP Directed Research:

This research is directed because NASA must define complete scientific activities in a short time and there is insufficient time to issue a solicitation. This task is in direct response to both the August 2014 HSRB requirement and the baselined HRP Path to Risk Reduction milestone of providing standard measures to monitor crew health and performance. This will allow HRP to establish, evaluate, and manage a common set of measures for use in spaceflight and analog research to: develop baselines, systematically characterize risk likelihood and consequences, and assess effectiveness of countermeasures that work for human factors and behavioral performance risk factors. This proposal qualifies for a directed study due to the urgent, time-sensitive need to provide "standard measures" as the foundation to achieve consistent research measure for data-sharing in HERA (Human Exploration Research Analog) and to meet the highly constrained, operationally-focused data gathering and analysis that allows for greater consistency in the research methods that are specific to NASA HRP standard measures development. Additionally, the set of BHP standardized measures in the HERA analogy reflects the more operational nature of the measures while allowing the multiple and

Rationale for HRP-Directed Research:	frequent internal and external collaborations required to execute this study. The directed nature of this study also allows NASA to provide the unique research and support expertise that is needed to integrate and manage the data from all of the various participating studies to achieve HRP's intent and support to the Flight Analogs Project (FAP) within a highly constrained time schedule. Completion of the required research, support to both analog and operational requirements, and vetting of the evidence-based standards makes the solicitation process prohibitive. In addition, our group, the BHP Lab has already performed similar work across various analogs in support of previous NASA research and the use of the BHP Lab offers considerable efficiencies that are realized by building upon our existing work and that expertise. Finally, two panels of extramural subject matter experts with experience in critical task identification in academic, military, and spaceflight analog settings met at Johnson Space Center (JSC) and provided recommendations consistent with the enclosed project related to team processes (November 2015) and psychometric assessment of cognition (April 2016).
Research Impact/Earth Benefits:	

Task Progress:	2018 June: End of Campaign 4, n=20 subjects over 5 missions (including Mission 2 which was shortened to 23 days due to Hurricane Harvey). Data yield is reported below for four categories in each mission: Overall Yield, Survey Yield, Wearables Yield (Actigraphy, Heart Rate, Sociometric Badges) and Objective Performance Yield (Cognition and ROBoT). Campaign 4 Mission 1: Overall Data Yield: 99.89%; Survey Data Yield: 99.96%; Wearables Data Yield: 93.15%; Objective Performance Data Yield: 98.50% Campaign 4 Mission 2: Percentage of expected data yield: Overall Data Yield: 55.38%; Survey Data Yield: 55.45%; Wearables Data Yield: 46.34%; Objective Performance Data Yield: 58.67% Percentage of possible data yielded due to shortened mission: Overall Data Yield: 99.95%; Survey Data Yield: 99.95%; Wearables Data Yield: 86.61%; Objective Performance Data Yield: 100.00% Campaign 4 Mission 3: Overall Data Yield: 96.33%; Survey Data Yield: 96.39%; Wearables Data Yield: 87.96%; Objective Performance Data Yield: 99.38% Campaign 4 Mission 4: Overall Data Yield: 96.03%; Survey Data Yield: 96.14%; Wearables Data Yield: 82.63%; Objective Performance Data Yield: 99.50% Campaign 4 Mission 5: Overall Data Yield: 96.74%; Survey Data Yield: 96.93%; Wearables Data Yield: 85.99%; Objective Performance Data Yield: 95.50% On average, the survey with the lowest data yield was the Pre-Sleep Survey (96%), which includes assessments of mood, neurobehavioral functioning (e.g., stress), and conflict. This survey had the most instances of completely missing surveys and partially incomplete surveys. This issue was addressed by adding "force response" criteria to our Qualtrics surveys which prevented subjects from skipping questions. On average, the wearables with the lowest data yield were the Polar heart rate monitors (78%). The lowest individual data yield was in Mission 3, in which one subject provided only 4 days of heart rate data out of 45 (.09%). The second lowest data yield was in Mission 4, in which one subject provided 7 days of heart rate data out of 45(.16%). We believe this was due to device malfunction and not abnormal noncompliance or human error. To address the concern of device malfunction, in Campaign 5 the Polar heart rate devices were replaced by Faros devices. 2020 February: Campaign 5 Missions 1-3 complete, n=12 subjects over 3 missions. Mission 4 in Progress. Data yield is reported below for four categories in each mission: Overall Yield, Survey Yield, Wearables Yield (Actigraphy, Heart Rate, Sociometric Badges) and Objective Performance Yield (Cognition and ROBoT). Actigraphy and SS Badge data are being processed, so Heart Rate data will be the only wearable reported below. Campaign 5 Mission 1: Overall Data Yield: 98.46%; Survey Data Yield: 98.43%; Wearables Data Yield: 100.00%; Objective Performance Data Yield: 98.91% Campaign 5 Mission 2: Overall Data Yield: 99.12%; Survey Data Yield: 99.16%; Wearables Data Yield: 88.89%; Objective Performance Data Yield: 98.00% Campaign 5 Mission 3: Overall Data Yield: 99.63%; Survey Data Yield: 99.71%; Wearables Data Yield: 98.33%; Objective Performance Data Yield: 93.11% Including "force response" parameters improved data yield for the pre-sleep survey, which had an average response rate of 99% in Campaign 5, as apposed to 96% in Campaign 4. Additionally, yield of heart rate data improved with the replacement of Polar devices (78%) with Faros devices (96%). BHP Lab next steps are to finish collecting Campaign 5 data, determine the yield of Actigraphy and Sociometric badge data, and to analyze the quality of data received.
Bibliography Type:	Description: (Last Updated: 07/05/2023)
Articles in Peer-reviewed Journals	Landon LB, Douglas GL, Downs ME, Greene MR, Whitmire AM, Zwart SR, Roma PG. "The behavioral biology of teams: Multidisciplinary contributions to social dynamics in isolated, confined, and extreme environments." Frontiers in Psychology. 2019 Nov 21;10:2571. Review. https://doi.org/10.3389/fpsyg.2019.02571 ; PubMed PMID: 31824374; PubMed Central PMCID: PMC6883946 , Nov-2019